

LACEY V. MURROW MEMORIAL BRIDGE  
(Lake Washington Floating Bridge)  
(Mercer Island Bridge)  
Interstate 90 spanning Lake Washington  
Seattle  
King County  
Washington

HAER No. WA-2

HAER  
WASH  
17-SEAT,  
13-

WRITTEN HISTORICAL AND DESCRIPTIVE DATA  
PHOTOGRAPHS

### History of the Bridge

Pontoon bridges have been used since antiquity. One of the earliest and more famous examples, designed by Herodotus, was the bridge Harpales built for the Persian King Xerxes across the Hellespont during his invasion of Greece (480 B.C.).<sup>1</sup> Such bridges have been preferred for short-term uses such as transporting armies over bodies of waters because of their temporary nature. They are vulnerable to fluctuations in water levels, currents, rough weather, ice, and debris.

On occasions, however, more permanent pontoon bridges have spanned major bodies of water, even in modern times. One example was a "submerged pontoon" bridge constructed at Calcutta in 1911.<sup>2</sup> A more celebrated example is a pontoon bridge built over the Bosphorus at the Golden Horn by the Turkish government in 1912, which succeeded several similar structures at the same site.<sup>3</sup> Pontoon bridges with swing spans were employed in Curacao in the Dutch West Indies (1923)<sup>4</sup> and in Chicago (1924).<sup>5</sup> A private company built a 1,300' long toll bridge with 128 pontoons fixed by 32 anchors at Mobasa Island, the chief port of Kenya, in 1931.<sup>6</sup> The type is not as rare as one might think. There are circumstances where a pontoon bridge can be a viable alternative, more so than "conventional" designs--especially when the water is so deep that bridges supported on piers are infeasible.

Such circumstances presented themselves at Lake Washington, just east of Seattle. The city is located just west of Baker Ridge and Lake Washington. Because of these two natural barriers, roads from the eastern part of Washington State had to circumvent them on the north or south. This became a problem as traffic gradually increased during the first half of the twentieth century.

The lake is 20 miles long from north to south, four miles across at most, and in some places, 220' deep. The bottom is a soft mud up to 200' deep. Piers for any sort of bridge would be problematical, to say the least.

Homer M. Hadley, an engineer who conceived several innovative concrete bridges in Washington during his career, is credited with being the first person to propose the idea of a concrete pontoon bridge across Lake Washington. According to later accounts, such as a 1964 *Seattle Times* article based on an interview of the man in his latter years, the idea occurred to him in 1921. Hadley, who at the time was an engineer working in an architect's office, was shaving one spring morning at his home in the South End of Seattle, which overlooked the lake. That is when the idea first occurred to him. It came naturally, as he had already designed concrete ships for the Emergency Fleet

HISTORIC AMERICAN ENGINEERING RECORD

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HAER  
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13-

HAER No. WA-2

Location: Interstate 90, spanning Lake Washington, Seattle, King County, Washington, beginning at mile point 4.24.

UTM: 10/553640/5270780  
10/556310/5270720

Quad: Seattle South, Wash.

Date of Construction: 1940, sunk in 1990 during refurbishing.

Engineer: Suggested by Homer M. Hadley, designed by the Washington Toll Bridge Authority

Fabricator: Built jointly by the Puget Sound Bridge and Dredging Co. of Seattle, Parker-Schram Co. of Portland, J. H. Pomeroy and Co. of San Francisco, and Clyde E. Wood of Los Angeles, under the name of the Pontoon Bridge Builders.

Owner: Washington Department of Highways. Since 1977, Washington State Department of Transportation, Olympia, Washington

Present Use: Rebuilt for continued use as a highway bridge.

Significance: Since construction, the bridge has been part of the major trunk route crossing the state and accessing Seattle from the east. It was a pontoon bridge of unprecedented scale and sophistication, and the first constructed of concrete. The bridge was removed from the National Register of Historic Places when it sank.

Historian: Wm. Michael Lawrence, August 1993

Corporation in Philadelphia during World War I.

His idea was for a series of concrete barges, linked end-to-end, with a roadway on the upper decks. He quickly drew a preliminary sketch of a cross section of a barge with three water-tight compartments. A more refined drawing, which appeared in the *Seattle Times*, depicts a section with a deck cantilevering out over the sides, slanted outward over the water, with an angled hull. A slight lip at the edge of the cantilevered parts of the decks would deter spray.

Hadley also understood that the location for the bridge and its approaches were critical. He recalled how he drove to Madison Park one Saturday afternoon and walked several miles along Mount Baker Ridge looking for its narrowest place, where a tunnel could be built as an approach from downtown Seattle to his bridge. He found it at Atlantic street, where the ridge dropped steeply towards the Lake on its western side:

I felt like Balboa when I discovered this place. . . . I was aware that the site of any future bridge would be an important factor in negotiations because of the high cost of constructing an approach. The spot I found is over the present tunnel, exactly 1,445 feet long. To have bored it on either side would have involved much greater expense.<sup>7</sup>

The other end of his bridge would have reached Mercer Island, requiring a second, much shorter, conventional bridge between the island and the mainland to the east.

Hadley attempted to find backing for his idea, but to no avail, and he became embroiled in subsequent public debates over building such a bridge over Lake Washington. Most capitalists he approached with the idea considered him a "screwball." When he became regional structural engineer for the Portland Cement Association, he found himself faced with outright opposition. "From then on," he recalled, "whenever I mentioned my idea, someone would express the fear that it was part of a nefarious plot of the cement companies to desecrate Lake Washington for profit."

Others made different proposals. In 1921, two engineers conceived the idea of building a pontoon bridge to replace ferry service across the lake, using fifteen wooden vessels owned by a local shipping board, surmounted with wooden superstructures and equipped with a draw span.<sup>8</sup> The proposal garnered little support. The Puget Sound Bridge and Dredging Company of Seattle investigated the idea of using wooden pontoons and sent an engineer to Turkey to examine the pontoon bridge at the Golden

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Horn. Another proposal, that of a tube under the lake, attracted only lukewarm support because it would cost \$12,000,000.<sup>9</sup> In 1931, the City Council held hearings on four applications for bridges at different locations and eventually approved a route at Seward Park was accepted. The company granted the franchise, however, they could not find financial backing.

In 1937, Hadley approached Lacey V. Murrow, director of the Washington Department of Highways, stating that he had found the most direct route for the bridge. His diary entry dated 10 June 1937 related that he spent an hour with Murrow, describing his design. "Lacey clicked and said to go ahead with some more data and he would have me loaned (by the cement association)." After Murrow's engineers examined various routes, they decided that Hadley's was the best, and despite opposition from residents of Mount Baker and Seward Park, it was eventually the new bridge's site.

Some citizens objected to Hadley's association with the project citing conflict of interest because of his affiliations with the cement industry. Nor would his design be accepted in its entirety. With Murrow and the highway department behind the project, however, it went forward in spite of the opposition.

The state legislature formed this agency in 1937, giving it the authority to establish and construct toll bridges, to issue bonds for to finance them, and to collect tolls for the retirement of the bonds.<sup>10</sup> The director of the Department of Highways headed this organization, which constructed the Lacey V. Murrow Memorial Bridge and the ill-fated Tacoma Narrows suspension bridge. A United States Public Works Administration grant of \$3,794,400 and toll bridge 4 percent revenue bonds totaling \$5,060,000 provided financing for the project.<sup>11</sup>

A short article written by Lacey V. Murrow in 1940 discussed the preliminary investigations. Having found Hadley's route acceptable, an intensive study of the question of a pontoon bridge began. The engineers involved were R. B. McMinn, bridge engineer from the U.S. Bureau of Public Roads' Portland, Oregon, office; Charles E. Andrew, was engineer for San Francisco-Oakland Bay Bridge; and members of the state highway department. According to Murrow, the participants reached a unanimous opinion that the conditions at Lake Washington were uniquely favorable for a pontoon bridge. It had "only a slight variation of its level, no current, no ice, no drift, and only limited reaches of open water in which waves could develop." The engineers considered making the pontoons of steel or of wood as well as of reinforced concrete, but concluded that concrete pontoons, with necessary anchorages, was not only lowest in cost but also was superior because its greater mass would make the bridge it more

stable.<sup>12</sup>

These studies, by the state highway department, included an experiment with a concrete barge anchored in Lake Washington, on the proposed route, from December 1937 to 31 March 1938. Various instruments on board recorded the tension in cables attached to the anchorages, daily weather conditions including wind direction and speed, the list of the barge, and the height of the waves. This taught the engineers much about the lake conditions and the possible behavior of pontoons.<sup>13</sup>

The board of consulting engineers approved a preliminary design for the proposed bridge on 26 February 1938, along with a plan of financing the project by a bond issue to be retired from tolls, and ordered immediate preparations of detailed plans and specifications. Since Lake Washington, was a navigable waterway, structures over it, by federal statute, needed U.S. War Department approval.<sup>14</sup> Hearings on this application were held in Seattle 4 May by the U.S. Army Corps of Engineers. The plans at this point called for overhead concrete and steel approaches extending 1,056' from the Seattle shore and 1,027 from Mercer Island, with the pontoon bridge proper 6,561' long. Within each approach would be a navigable span 150' long and with 30' vertical clearance, while a sliding connection in the pontoons would provide a 200'-wide opening for larger ships.<sup>15</sup> The final design would not vary greatly from this one.

Bids were taken in November on 11 different kinds of work for the project. The contracts included the 6,500' foot long pontoon bridge proper, the two approaches at 2,022' each, the 1,500' twin-bore tunnel through Mount Baker, 16,600' of 4-lane concrete pavement, a 2,758' concrete viaduct across Mercer Slough, a steel and reinforced concrete bridge across the east arm of Lake Washington, and concrete overpasses and paving in Seattle.<sup>16</sup> The ground-breaking ceremonies by Governor Clarence D. Martin, with Lacey V. Murrow and scores of other dignitaries present, took place on 29 December 1938.<sup>17</sup> The work began in short order. By February 1939, construction of the graving docks, where the pontoons would be poured, began. Fabrication of the first pontoon began on 2 May. The last pontoon would be launched on 9 April 1940.<sup>18</sup>

The huge project could not help but draw attention from the general public and the press. A 14 June 1939 article in the *Seattle Times*, for example, featured photographs of various operations: the construction of the pontoons at Harbor Island, from which they would be floated through the Lake Washington ship canal to the site, the excavations for the approaches and their construction, and the boring out of the tunnel.<sup>19</sup> The placement and anchorage of the first pontoon was a special event, recorded

on 9 July.<sup>20</sup> Aspects of the technology involved fascinated everybody watching from the shores, as on 10 August:

Four more huge black anchors, numbered respectively in white paint five, seven, and eight, are now on Lake Washington at the bridge site, ready to be lowered into the murky depths as anchorage for the pontoons. . . . Bridge engineers have made many assurances that under no circumstances could the anchorage drag. . . . All their words stacked together could not offer the assurance given by just the sight of those huge anchors, each as big as a small house.<sup>21</sup>

Installation of "rocking chair" devices in April was of special interest. These supported the transition span connecting the pontoons with the approaches and allowed the span to flex and twist as the pontoon span moved with the lake level. The public was fascinated by the technology involved in this unprecedented structure.<sup>22</sup>

The bridge was formally dedicated with great fanfare on 2 June 1940. Two thousand people gathered on the east end and along the shore. A ribbon was cut, an urn containing water from 58 streams and lakes in Washington was smashed against the side of the bridge, the Seattle Breakfast Club had its morning meal under the west approach, and an army band played for the crowds. Festivities included swimming races, fancy diving, surf boarding, and water skiing exhibitions.<sup>23</sup>

The new route over the lake was very popular with the public. Tolls during the first two months of operation exceeded estimates, totalling \$107,770.<sup>24</sup> By enabling automobiles to travel easily across the lake to Mercer Island, it encouraged many to build homes there and to commute to and from Seattle. The result was ironical, for the bridge was built in part to solve transportation problems for people living on the east side of the lake, but it worsened the problem, as increased traffic rendered the structure inadequate. This would result in the alterations, one of which led to the accidental destruction of the bridge in 1990. It is currently being rebuilt.

The bridge, because it was the gateway to Seattle from a national highway to the east, naturally became a symbol of the "Emerald City," like Mount Rainier, or the Space Needle built two decades after the bridge. The bridge was placed on the National Register, but was removed when it sank.

When Lacey V. Murrow died in 1967, the state renamed the structure in his honor. Some felt that it should have been named after Homer M. Hadley, who first proposed the idea for such a

bridge. Long after the death of both men, a new pontoon structure built alongside the old one was named in Hadley's honor. When the replacement for the old bridge is completed it shall be named after Murrow.<sup>25</sup> It is perhaps fitting that the two structures, side by side, will honor the man who first conceived the idea of a concrete pontoon bridge and the man who was largely responsible for transforming the idea into a reality.

### Description and Design

The Lake Washington or Lacey V. Murrow floating bridge is one of the most celebrated engineering achievements in the northwestern United States. A series of articles, authored by highway department officials who were members of the engineering team responsible for the project, were published in *Pacific Builder and Engineer* shortly after its completion. Together, they describe the structure and explain its design. The following is a summary of the contents of those articles.

The bridge consisted of several distinct parts: the pontoons proper; the cables securing the pontoons to the underwater anchors; the anchors themselves, of which there were three types; the sliding draw pontoon near the center of the pontoons; and the transition span between the approaches and the pontoons. The Mount Baker Ridge Tunnel (HAER No. WA-109) is discussed in a separate report. The reinforced concrete pontoons and the draw spans were unprecedented in the history of bridge building.

The twenty-five reinforced concrete pontoons were of varying lengths, and totalled 6,620'. These were flat-bottomed with straight sides, 59' wide and from 117' to 378' long. Ten were 14'-6" deep, drawing 7' of water, while others varied from 7' to as much as 14' in draft. They were divided internally by individual cells, 4 across in each pontoon. Outside walls and bottoms were 8" thick, the inner walls 6". Every second transverse wall was watertight. Reinforcing was heavy, presumably for maximum strength in the thin walls.

They were constructed in two graving docks built on Harbor Island, at the south end of the Seattle harbor and at the mouth of the Duwamish River. Both were 15' deep, 70' wide, one being 400' long and the other 365' in length. The floor consisted of 30 inches of concrete poured around wood piles whose heads protruded 6 inches above the floor. A timber floor of shiplap was laid on the pile heads, serving as the bottom form for the pontoons. The space below permitted water to flow beneath the finished structures. Tongue and groove timber sheet piling, held in place by anchor piles, formed the walls. The channel side was closed with timber gates backed by steel trusses.

Each pontoon was cast in two continuous pours: the hull and deck. The procedure consisted of nine steps: 1) placing the reinforcing for the bottom slab, 2) placing cell forms and interior reinforcing, 3) placing the outside wall reinforcing and forms, 4) pouring the hull and interior walls, 5) stripping the forms, 6) applying membrane cure, 7) placing the deck forms and reinforcing steel, 8) pouring the slabs and, 9) stripping the outside wall forms and launching the pontoon by flooding the dock.

After launching, the builders towed the pontoons to Lake Union, where rails were poured, then through the ship canal to Lake Washington and the site. Here they were assembled and secured to anchors already imbedded in the lake bottom. Triangulation using radio transmitters expedited location of the anchors and the pontoons.

The pontoons were solidly bolted together with 54 bolts at each joint. A rubber gasket create a gap between the pontoons which was filled with grout. The result was one solid boat over 6,000' long, except for the sliding draw, in effect two enormous box girders supported by water.<sup>26</sup>

Three kinds of anchors were used for differing conditions: 1) "Type A" anchors used in soft mud in the deepest water, averaging 200' down, 2) "Type B" anchors for deep water and hard bottom, and 3) "Type C" anchors for shallow water and hard bottom.

Forty-one of the anchors were of the "Type A." Each was V-shaped in plan, 26' in spread, 12' high, constructed of reinforced concrete 12" thick, and weighing, together with its eye-bar connector, 65 tons. Sixteen vertical jet hoses were connected to each. The anchor was lowered into place in the murky depths and 2,500 gallons of water per minute was pumped through the jets at 200 lbs. pressure causing the anchor to bury itself in the soft clay, except for eye-bar.

The "Type B," of which 4 were built and used in places where the bottom was too hard for jetting, was a bit simpler. Each consisted of a huge reinforced concrete box, open at the top, with the forward wall extending 12" inches below the bottom of the box to increase "drag weight." These were fabricated at Harbor Island, floated to the site, filled with water and 85 tons of rubble, sunk into position, then filled with 400 tons of gravel placed by means of a 16"-diameter iron pipe.

Each of the 19 "Type C" anchors consisted of two 24" x 33" steel piles, one 27' and the other 20' long, driven 16' into the bottom at 20' apart. The anchor cable was attached to the bottom of the long pile and huge turnbuckle connected the top of this pile with

the bottom of the other. Driving the piles involved the use of a timber template to space them correctly. The Type C's were used in "shallow" water, where the bottom was less than 90' below the surface.

A specially designed mechanism was used to maintain a constant tension in the 2-3/4" cables connected to these anchors. Two of the cables entered each pontoon, one on each side, at its middle, at 1' below the water level and at 22 degrees from level. Each entered through a water-tight hawse, passed over a cast-steel saddle set in the concrete, and then proceeded to a large steel jacking casting. This casting could move back and forth in a channel frame set in a slot in a transverse wall. Two 25-ton hydraulic jacks were used to move the casting back and forth a distance of 12' x 9". This system was capable of maintaining the proper tension in the cables necessary to keep the bridge in place despite wind, waves, and annual 4' fluctuations of the lake level.<sup>27</sup>

The sliding draw span, like the concrete pontoons, was another first in engineering history. Capable of opening to leave a clear channel of 200', it consisted of a floating draw pontoon that was 59' wide, 14'-6" deep, and 378' long. It moved back and forth in a slot between flanking guide pontoons, each 30' wide and 15-1/2' deep. The four-lane roadway would split at this "bulge," as it was later known, diverging onto the guide pontoons then reuniting on the draw pontoon.

Guide rollers along the sides of the draw pontoon fitted into tracks in the guide pontoons and maintained the correct elevations and alignment of the roadways. The machinery for moving the draw pontoon consisted of two 75-horsepower electric motors located in the pontoon just behind the draw. The motors drove drums around which were steel cables wound in opposite directions. The cables passed over sheaves into the track of the guide pontoons and around sheaves into and through the pontoon. Rotating the drums in one direction retracted the draw pontoon and reversing the motors pulled them back into the closed position. The mechanism could open or close the 10 million pound draw pontoon in only 1-1/2 minutes.<sup>28</sup>

A primary problem with pontoon bridges, which limits their application, is maintaining a roadway between the land and a structure which may move up and down with the water level, as well as longitudinally, or laterally. The transition in the Lake Washington floating bridge was effected with 918' of the transition pontoons and a 150' steel deck truss, at each end of the bridge. The transition span was supported with hinged connections at both ends.

Each group of transition pontoons was connected to rest of the pontoons by a "vertically articulated joint" or "hinge in a horizontal plane that allows the pontoons to rotate in a vertical plane." The bridge therefore consisted of the following: approaches supported by trusses on piers, a hinge, truss transition section, another hinge, a series of transition pontoons, an articulated joint, another series of pontoons, the sliding draw, and then, the whole sequence repeated, but in reverse.

The problem here consisted of maintaining a minimal change of grade at the hinges despite gradual lake level fluctuations of 3', annually. The roadway approached the transition span with a grade of 5 percent. When the lake level was high, the grade on the transition span was 4.27 percent and the roadway on the transition pontoons gradually changed in grade from 5 to 0 percent, from hinge to hinge, with the pontoons on an even keel. At low lake level, the grade on the transition span was 5.08 percent, while the grade of the roadway on the pontoon span changed from 5.27 to 0.27 percent, from hinge to hinge. At low level the transition pontoons were no longer level, however, for the end at the transition span was 2'-6" higher than the end at the articulated joint. Grade changes between the roadway surfaces on either side of the hinge or articulated joint would never exceed 0.27 percent.

This was accomplished with water ballast inside the transition pontoons, which could be automatically regulated as the lake level changed. A master float next to one of the piers supporting the approach sensed lake level changes while a float in each group of cells within the pontoons sensed the level of water inside. The information was fed to electrical "Selsyn" units which regulated a system of electric pumps and valves which could change these water levels and, consequently, the keel of the transition pontoons, raising and lifting the shore end by 2"-6" with respect to the lake level.

The construction of the 150' transition span was not simple, when compared with standard steel spans. At the pier end, each of the two trusses rested on a segmental rocker with a 1'-4" radius, while a similar rocker, with a radius of 3'-8", supported the other end. Trusses were connected with universal joints to these rockers. These allowed the trusses to move in any direction with respect to each other. The decking on this span was a steel grid and the cross beams were pin-connected, accommodating any twisting of the structure.<sup>29</sup>

All that survives of the original pontoon bridge project are the approaches to the transition span, along with the roads leading up to them, which were impressive projects in their own right,

but less unique. These are of reinforced-concrete decks, girders, and piers. The pier-supported spans just next to the moving transition spans are steel bow-string through trusses, allowing the passage of smaller vessels below. Ironically, they are the most distinct parts of the pontoon bridge, visually, and any photograph or emblem depicting the bridge will include them.

### Repair and Maintenance

With time and increasing traffic, the "bulge" around the sliding draw, which obliged motorists to negotiate a sharp curve at high speed, became an accident-prone area and the bridge became notorious for sometimes fatal mishaps. The Washington Department of Highways replaced the bulge with straight pontoons in 1981.

As early as 1956, some called for a second floating bridge, running parallel to the 1940 structure, to solve the problem of increasing traffic loads.<sup>30</sup> Its construction began in 1986 and was completed in 1989.

Work then began on renovation of the original floating bridge. This involved removing the sidewalks, which were an integral part of the pontoons, to widen the traffic lanes. Hydro-demolishers were used to remove the concrete and access holes were cut into the sides of the pontoons. During the course of this project, on 25 November 1990, the original bridge sank due to an excess accumulation of water within the pontoons. At this writing, the legal ramifications are still being sorted out. A replacement, a new pontoon bridge using the original approaches, is now being built.

### Data Limitations

There is no lack of information available, regarding this bridge. At least a dozen period articles in professional journals discuss its construction. A series in the *Pacific Builder and Engineer* was particularly helpful. Newspaper clipping files at the Washington State Library in Olympia, the Seattle Public Library, the Washington State Historical Society Library in Tacoma, the Special Collections Room at the University of Washington Library, and the Seattle Historical Society Library at the Museum of History and Industry provided more than enough newspaper articles regarding this landmark bridge. In addition, the Washington State Department of Transportation has kept voluminous files of working drawings and other documentation. The real limitation was time, necessitating selecting individual sources that were most helpful while excluding others.

### Project Information

This project is part of the Historic American Engineering Record (HAER), National Park Service. It is a long-range program to document historically significant engineering and industrial works in the United States. The Washington State Historic Bridges Recording Project was co-sponsored in 1993 by HAER, the Washington State Department of Transportation (WSDOT), and the Washington State Office of Archeology & Historic Preservation. Fieldwork, measured drawings, historical reports, and photographs were prepared under the general direction of Robert J. Kapsch, Ph.D., Chief, HABS/HAER; Eric N. DeLony, Chief and Principal Architect, HAER; and Dean Herrin, Ph.D., HAER Staff Historian.

The recording team consisted of Karl W. Stumpf, Supervisory Architect (University of Illinois at Urbana-Champaign); Robert W. Hadlow, Ph.D., Supervisory Historian (Washington State University); Vivian Chi (University of Maryland); Erin M. Doherty (Miami University), Catherine I. Kudlik (The Catholic University of America), and Wolfgang G. Mayr (U.S./International Council on Monuments and Sites/Technical University of Vienna), Architectural Technicians; Jonathan Clarke (ICOMOS/Ironbridge Institute, England) and Wm. Michael Lawrence (University of Illinois at Urbana-Champaign), Historians; and Jet Lowe (Washington, D.C.), HAER Photographer.

## APPENDIX

### Designers and Builders

Homer M. Hadley is credited with the original concept of a concrete pontoon bridge across Lake Washington, as well as with locating its site. The bridge was designed by the Washington Toll Bridge Authority, an agency of the Washington Department of Highways. Lacey V. Murrow, Director of the highway department and chief engineer of the Authority, made the decision to use Hadley's idea to solve the problem of vehicular transportation across Lake Washington, albeit with some modifications, and pushing the project through to completion.

The design team for the project was large. Key personnel included R. B. McMinn, bridge engineer for the U.S. Bureau of Public Roads and Charles E. Andrew, chairman of the board of consulting engineers for the Washington Toll Bridge Authority. Others included E. B. Woolliscroft, designing engineer for the authority; L. R. Durkee, Public Works Administration Project Engineer for the Lake Washington and Tacoma Narrows Bridges; Richard Barber, Resident Engineer, Units 3 and 4, Lake Washington Toll Bridge Authority; E. H. Thomas, Office Engineer, Lake Washington Floating Bridge; Champ E. Corser, Bridge Designer for the Lake Washington Toll Bridge Authority; Harold V. Judd, Engineer-Inspector, PWA, Lake Washington Floating Bridge; R.H. Thompson, Consulting Engineer; and R. M. Murray, Lake Washington Bridge Engineer.

The floating portion of the structure was built by Pontoon Bridge Builders, a merger of Parker-Schram Co. of Portland, J. H. Pomeroy of San Francisco, Puget Sound Bridge & Dredging Co. of Seattle, and Clyde W. Wood of Los Angeles. At its peak, Pontoon Bridge Builders employed 650 men for this project.<sup>31</sup>

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ENDNOTES

<sup>1</sup> David B. Steinman and Sara Ruth Watson, *Bridges and Their Builders* (New York: G.P. Putnam's Sons, 1941), 24-27.

<sup>2</sup> "A Pontoon Bridge with Submerged Pontoon," *Engineering News* 68 (1912): 148.

<sup>3</sup> F. C. Coleman, "New Pontoon Bridge over the Golden Horn at Constantinople," *Engineering News* 70 (20 November 1913): 1018-1020.

<sup>4</sup> Baird Snyder, "Pontoon Swing Bridge at Curacao in the Dutch West Indies," *Engineering News-Record* 93 (16 October 1924): 620.

<sup>5</sup> "Cable-Operated Pontoon Bridge Over Chicago River--Temporary Draw Span Completes New Thoroughfare--Safety Barrier Protects Highway Traffic," *Engineering News-Record* 93 (27 November 1924): 864-65.

<sup>6</sup> "Long Pontoon Bridge Built in Africa," *Engineering News-Record* 107 (15 October 1931): 611.

<sup>7</sup> Lucille McDonald, "The Inspiration For the First Floating Bridge." *The Seattle Times*, 26 July 1964.

<sup>8</sup> "Pontoon Bridge Proposed to Relieve Seattle Ferries," *Engineering News-Record* 87 (22 September 1921): 511.

<sup>9</sup> James Warren, "The idea of a floating bridge surfaced in 1920." *Seattle Times*, 27 February 1983.

<sup>10</sup> Washington, Department of Highways, *Eighteenth Biennial Report of the Director of Highways, 1938-1940*, 29.

<sup>11</sup> Ibid., 34.

<sup>12</sup> Lacey V. Murrow, "Early History of the Lake Washington Floating Bridge," *Pacific Builder and Engineer* 46 (5 October 1940): 46. Reprinted in *Bridges of 1940 built by Washington Toll Bridge*

Authority, 46-47. This was a pamphlet published by the convention committee for the 26th annual convention of the American Association of State Highway Officials.

<sup>13</sup> "Barge Tests Feasibility Of Pontoon Bridge," *Engineering News-Record* 120 (27 January 1938),

<sup>14</sup> "The Week's Events," *Engineering News-Record* 120 (10 March 1938): 381.

<sup>15</sup> "Hearings to Be Held On Pontoon Bridge," *Engineering News-Record* 120 (28 April 1938): 631.

<sup>16</sup> For a list of the contractors involved in this project, see Appendix.

<sup>17</sup> "Governor Martin Breaks Ground on Lake Washington Bridge Project," *Pacific Builder and Engineer* 45 (7 January 1939): 33.

<sup>18</sup> Richard Barber, "Massive Concrete Pontoons--Procedure followed in building, launching, and placing the pontoons which form the Lake Washington Floating Bridge," *Pacific Builder and Engineer* 46 (3 August 1940): 41-43. Reprinted in *Bridges of 1940 built by Washington Toll Bridge Authority*, 21-23.

<sup>19</sup> "A Dream That Is Coming True--The Lake Washington Bridge," *Seattle Times*, 14 June 1939.

<sup>20</sup> "Lake Bridge Pontoon Anchored," *Seattle Post-Intelligencer*, 10 August 1939.

<sup>21</sup> "First Million," *Seattle Times*, 19 July 1939.

<sup>22</sup> "'Rocking Chair Span' Put in Place," *Seattle Post-Intelligencer*, 16 April 1940, II-13.

<sup>23</sup> "Lake Washington Bridge Formally Opens," *Seattle Times*, 2 July 1940, 1 & 10.

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<sup>24</sup> "Tolls from Washington spans exceed estimate," *Engineering News-Record* 123 (10 October 1940): 43.

<sup>25</sup> Mark Higgins, "Floating bridge to bear name of innovator Hadley--Interstate 90 span to be dedicated today," *Seattle Post-Intelligencer*, 17 July 1993, B-1 & B-3.

<sup>26</sup> The pontoons were discussed in Richard Barber, 41-43.

<sup>27</sup> L. R. Durkee, "Believe it or not . . . Floating Bridge More Stable Than Fixed Spans." *Pacific Builder and Engineer* 46 (3 August 1940): 38-41. Reprinted in *Bridges of 1940 by the Washington Toll Bridge Authority*, 18-21.

<sup>28</sup> E. B. Woolliscroft, "Another New Precedent in Bridge Design . . . World's First Draw Pontoon--The 'Draw-Span' of Lake Washington Floating Bridge weighs ten million but it can be opened in 1-1/2 minutes," *Pacific Builder and Engineer* 46 (3 August 1940): 46. Reprinted *Bridges of 1940 built by Washington Toll Bridge Authority*, 17.

<sup>29</sup> Champ E. Corser, "Movement Due to Variations in Lake Level, Temperature and Wind Controlled by The Transition Section." *Pacific Builder and Engineer* 46 (3 August 1940): 44. Reprinted in *Bridges of 1940 built by Washington Toll Bridge Authority*, 27. The explanation is not well-written and a long study was required before it could be understood. Hopefully, this explanation is clearer.

<sup>30</sup> "Bridge Beside Old Structure Favored," *Seattle Times*, 15 July 1956, 1 & 2.

<sup>31</sup> *Bridges of 1940 built by Washington Toll Bridge Authority*, 23.